

NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 10-93

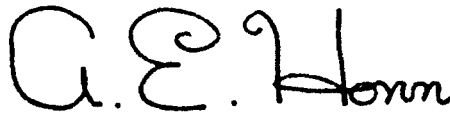
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Subj: GUIDE TO THE ACCEPTANCE OF NATIONAL FIRE PROTECTION ASSOCIATION
CODE NO. 13 FOR AUTOMATIC SPRINKLER SYSTEM DESIGN, INSTALLATION AND
MAINTENANCE

1. PURPOSE. This Circular adopts, with modifications, the National Fire Protection Association's sprinkler system design standard known as NFPA 13 for shipboard use.
2. DIRECTIVES AFFECTED. None.
3. DISCUSSION.
 - a. The success of automatic sprinkler systems in protecting shore structures from fire has sparked great interest in the marine community. A highly effective automatic sprinkler system can allow more design flexibility and provide a level of safety beyond that provided by the design requirements of current regulation. NFPA 13 is a rigorous design standard that represents knowledge gained through decades of land-based automatic sprinkler system experience and research. When modified to reflect the uniqueness of shipboard installations, it provides a progressive design standard for shipboard automatic sprinkler systems which permits maximum flexibility in vessel design and incorporation of advanced technology.
 - b. The current regulations concerning automatic sprinkler systems are contained in 46 CFR, Subchapter H. These regulations do not include the advancement in sprinkler system technology and efficiency that have occurred during the past several decades. With its rigid pipe schedule system, the current sprinkler regulations of Title 46, Code of Federal Regulations do not include new technologies such as quick response sprinkler heads, hydraulic calculation techniques for water flow, and provisions for nonmetallic piping. NFPA 13, on the other hand, includes these new technologies as well as alternative system layouts and multiple occupancy classifications. This flexibility enhances vessel safety by providing the ability to design a sprinkler system that can meet any particular fire challenge that might be found on-board a vessel.
 - c. Despite the enhanced fire protection offered by advanced sprinkler system technology, passive fire protection measures such as fire rated boundaries and noncombustible construction still ensure the safety of the vessel. Crew training is also of paramount importance.

4. IMPLEMENTATION.

- a. The articles contained in NFPA 13 will be accepted as an alternative to the regulations contained in 46 CFR 76.25 subject to the deletions, modifications and additions of enclosure (1). It is recommended that plans for shipboard sprinkler systems be reviewed and approved by a licensed Professional Fire Protection Engineer prior to submission to the Marine Safety Center.
- b. In the future, the Coast Guard intends to pursue the use of this guidance as the framework from which a standards making organization, such as NFPA, can develop a marine automatic sprinkler standard. Once developed, the standards will be adopted to replace the current sprinkler regulations.

A handwritten signature in black ink, appearing to read "A. E. HENN". The signature is stylized with a large "A", a cursive "E", and a cursive "H" followed by a flourish.

A. E. HENN
Rear Admiral, U.S. Coast Guard
Chief, Office of Marine Safety, Security
and Environmental Protection

End: (1) Guide to the Acceptance of NFPA 13 for Automatic Sprinkler System Design, Installation and Maintenance

Guide to the Acceptance of NFPA 13 for Automatic Sprinkler System Design, Installation and Maintenance

The following guidance outlines the deletions, modifications and additions that were necessary in order to make NFPA 13 (1991 Edition) acceptable for shipboard use. The primary modifications regard pipe hanging, water supply, design methods and application density requirements. Changes to the standard are necessary in these areas to reflect unique shipboard factors such as environment, evacuation, safe refuge arrangement and the existence of an independent firemain system. Paragraphs contained in NFPA 13 that are not specifically addressed herein are accepted as written. The goal of this guidance is to preserve, as much as possible, the acceptability of materials and system components based upon current listing requirements. Additional testing and modifications have been made where shipboard requirements vary from land-based applications. Commandant (G-MTH-4) should be contacted with any questions concerning the acceptability of listed materials and components, particularly when special listings or new listing categories are developed.

Chapter 1 General Information

1-4.1 The following definitions shall be modified:

Approved: Issuance of "Approval" stamp or letter certifying acceptance by the Commanding Officer, Marine Safety Center or any other organization authorized by the Commandant.

Authority Having Jurisdiction: The elements of the Coast Guard listed in Table 1.1 shall be deemed to be the "Authority Having Jurisdiction."

Listed: Automatic sprinkler system components shall be listed for exposure to salt water when such service is expected.

The following definitions shall be added:

Central Safety Station: A continuously manned Control Station from which all of the fire control equipment is monitored. If this station is not the bridge, direct communication with the bridge shall be provided by means other than the ship's service telephone.

Maximum Allowable working Pressure: The maximum possible steady state pressure to which the system can be subjected. This pressure shall not exceed the pressure rating of the system component which has the lowest maximum pressure rating.

Supervision: A visual and audible alarm signal given at the central safety station to indicate when the system is in operation or when a condition that would impair the satisfactory operation of the system exists. Supervisory alarms shall give a distinct indication for each individual system component that is monitored.

Water Supply: The supply portion of the sprinkler system from the water pressure tank or the sea suction of the designated sprinkler system pump up to and including the valve which isolates the sprinkler system from these two water sources.

Table 1.1 Areas of Approval Responsibility

Coast Guard Office	Approval Responsibility
Commanding Officer, Marine Safety Center	Plan Review
Commandant (G-MVI-3)	System, Component and Listing Acceptance
Officer in Charge, Marine Inspection, Marine Safety Office	Installation, Inspection, Testing and Maintenance
Commandant (G-MTH-4)	Overall Policy Determination, Appeals, Novel System Concept Review

1-4.2 The following general definitions shall be modified:

Limited-Combustible Material: Delete.

Noncombustible Material: Any material currently issued an approval number under 46 CFR 164.009 by Commandant (G-MVI-3).

Thermal Barrier: A material that meets at least the B-15 fire rating standard as defined in 46 CFR 72.05-10(c) and is currently issued an approval number under 46 CFR 164.008 or 46 CFR 164.010 by Commandant (G-MVI-3).

The following general definitions shall be added:

Combustible Material: Any material which is not designated as a noncombustible material.

Fire Pump: The pump installed for the purpose of supplying the water demand requirements of the firemain system.

Heat Sensitive Material: A material whose melting point is below 926.7°C (1700°F).

Sprinkler Pump: An automatically controlled pump that is installed for the sole purpose of supplying the water demand requirements of the sprinkler system.

1-4.7 Modify: In addition to the examples provided in Appendix A of the standard, Table 1.2 provides examples of occupancy definitions of typical shipboard spaces.

The classifications in Table 1.2 are not meant to be applied without giving consideration to the definition of each occupancy hazard given in the standard. Table 1.2 is general guidance for classification of typical spaces. When a space is outfitted such that the occupancy definitions indicate that another classification would be more appropriate, the most representative and most demanding occupancy classification shall be used. For example, it would certainly be possible to outfit a stateroom to require upgrading the occupancy to Ordinary Hazard Group 1. Review of occupancy determinations shall be performed during plan review at the discretion of the Commanding Officer, Marine Safety Center and material installations verified by the Officer in Charge, Marine Inspection. Where it is felt that the standard is not clear or the occupancy rating allowed by the Marine Safety Center is appealed, Commandant (G-MTH-4) shall determine the appropriate occupancy rating that will be used.

When a vessel undergoes modifications, alterations or service changes that significantly effect the fire risk of the occupancy of one or more compartments, the occupancy classification should be reevaluated to determine if it has changed.

To assist in determining the occupancy classification of a compartment the following excerpts are taken from the Automatic Sprinkler Handbook¹:

"Light Hazard Occupancies, as defined in this section, offer the least challenge to sprinkler systems. The nature of occupancies in this classification results in low fuel contribution. Generally there is no processing, manufacturing, or large storage accumulation. Fixtures and furniture remain fairly fixed arrangements in this group of occupancies. Mainly, these are institutional, educational, religious, residential, and office-type properties."

¹ Solomon, Robert E., Automatic Sprinkler System Handbook National Fire Protection Association, Quincy, MA 02269.

Table 1.2: Examples of Shipboard Space Occupancy Classification

Occupancy Type	Space Types Included		Examples
	CFR ²	SOLAS ³	
Light Hazard	1 ⁴ , 2, 3, 4, 5, 8, 13	1 ⁴ , 2, 3, 4, 5, 9, 10	
Ordinary Hazard (Group 1)	1 ⁴ , 6, 7, 8, 9 ⁵	1 ⁴ , 3, 5, 9	Galleys Storage Areas Laundries Pantries with high heat source equipment
Ordinary Hazard (Group 2)	9 ⁵ , 11 ⁵	5 ⁵ , 8 ⁵ , 9, 11	Sales Shops Stages (with sets) Machine Shops
Extra Hazard (Group 1)	1, 9 ⁵ , 10, 11 ⁵	1, 5 ⁵ , 7, 8 ⁵	Auxiliary Machinery - limited combust. liquids Steering rooms - combust. hydraulic fluid in use
Extra Hazard (Group 2)	1, 9 ⁵ , 10, 11 ⁵	1, 5 ⁵ , 6, 7, 8 ⁵	Aux. Machinery - with combust. liquids Machinery Spaces

"Ordinary Hazard Occupancies include a wide range of occupancy types...

Group 1 occupancies offer the lowest sprinkler system challenge of the Ordinary Hazard Occupancies and are comprised mostly of light manufacturing and service industries. Use of flammable and combustible liquids or gases is either very limited or so arranged that it presents little challenge to sprinklers. Stockpiles of combustible commodities having Group 1 characteristics that are not within the scope of NFPA 231, Standard for General Storage, and are not over 2.4 m (8 ft) high are Ordinary Hazard (Group 1) Occupancies. This would include any items that are treated as miscellaneous storage.

Ordinary Hazard (Group 2) Occupancies cover the remainder of the Ordinary Hazard classes. Most of the Ordinary Hazard Occupancies fall into this group. They represent the norm or the average occupancy for manufacturing and processing industries. This category would include miscellaneous storage of contents up to and including 3.7 m (12 ft).

² Space type definitions are given in 46 CFR 72.05-5.

³ Space type definitions are given in the 1974 Safety of Life at Sea Convention (SOLAS 74), as amended, Regulations 3, 26, 27 and 44.

⁴ Primarily for accommodation type control stations. not include generator or other similar type spaces.

⁵ Depends on storage type, quantity and height and distance below sprinkler deflectors (must maintain 0.46 m (18 in) clearance).

When attempting to classify occupancies that are decidedly not Light Hazard or Extra Hazard, the Group 2 classification should be considered first. Those that do not compare well with the examples of Group 1 occupancies are most probably of the Group 2 classification."

"Extra Hazard Occupancies represent the occupancy fire conditions covered by this standard which provided the most severe challenges to sprinkler protection. The Extra Hazard (Group 1) Occupancies include those in which hydraulic machinery or systems with flammable or combustible hydraulic fluids under pressure are present. Ruptures and leaks in piping or fittings have resulted in fine spray discharge of such liquids, causing intense fires to result. Those occupancies with process machinery that use flammable or combustible fluids in closed systems are Extra Hazard (Group 1). Also in this group are occupancies that have dust and lint in suspension or that contain moderate amounts of combustible cellular foam materials. Buildings used for textile manufacturing are one example of an extra hazard occupancy.

The Extra Hazard (Group 2) Occupancies contain more than small amounts of flammable or combustible liquids, usually in open systems where rapid evaporation can occur when subjected to high temperatures.

This occupancy classification also applies when ceiling sprinklers are obstructed by occupancy conditions, and water discharged by sprinklers may not reach the burning material because of the shielding.

The Extra Hazard Occupancy examples were classified on the basis of actual field experience with sprinkler system operations in those kinds of occupancies shown in the examples."

It must be noted that these definitions are not the same as those published in the Life Safety Code.

- 1-6.2 Modify: Partial installations of automatic sprinklers should, in general, not be permitted. Experience has shown that structures which are partially sprinklered can be overrun by well developed fires originating in unsprinklered areas. Therefore, the entire vessel should be sprinklered whenever sprinkler systems are considered. Partial sprinkler installations shall only be permitted when specifically accepted by Commandant (G-MTH-4).

Chapter 2 System Components and Hardware

- 2-1.2 Modify: Where the maximum allowable working pressure of a system component, such as a valve or a fitting, is less than that computed or listed for the pipe or tubing, the system pressure shall be limited to that of the component with the lowest maximum allowable working pressures (46 CFR 56.07-10). No component shall be rated for less than 1.2 MPa (175 psi).
- 2-2 Add: Sprinkler heads fabricated with silicon brass alloy UNS C87800 may not be installed. Research has indicated that this material may have severe corrosion problems when subjected to the marine environment.
- 2-2.2.1 Modify: A sprinkler orifice shall not be less than a nominal 9.5 mm (3/8 inches) in size. Minimum operating pressure shall be 68.9 kPa (10 psi). Attention is called to this minimum 68.9 kPa (10 psi) design and operating pressure requirement which exceeds the typical 48.3 kPa (7 psi) for land-based systems.

- 2-2.5.1 Modify: Sprinkler head penetrations through rated ceilings or bulkheads shall comply with the penetration requirements of Navigation and Vessel Inspection Circular 6-80 (NVIC 6-80). Where clearances are in excess of those allowed in NVIC 6-80, nonmetallic escutcheon plates shall not be used.
- 2-2.7.1 Add: The cabinet containing spare sprinklers, special wrenches and elastometric gaskets shall be located in the same central safety station that contains the alarm annunciator panel(s) and supervisory indicators.
- 2-2.7.2 Add: A special wrench for each type of sprinkler head shall be kept in the cabinet.
- 2-2.7.3 Modify: The required stock of spare sprinklers shall be carried for each type of sprinkler installed on board the vessel. Where less than six sprinklers are installed of a particular type, 100% spares shall be kept in stock. Where applicable, at least one elastometric gasket shall be kept in the cabinet for each fire department connection that is installed on board the vessel.
- 2-3.1 Modify: All the materials listed in NFPA 13, Table 2-3.1 are acceptable for use except Brazing Filler Metal (AWS A5.8). Where ferrous materials may be subjected to salt water, the materials must be protected against corrosion by hotdip galvanizing or by the use of extra heavy schedule material. (See 46 CFR 56.60-3(a).)
- 2-3.4 Add: Maximum design pressure for copper and brass pipe shall not exceed that permitted by 46 CFR 56.10-5(c).
- 2-3.5 Modify: Materials other than those meeting the requirements of NFPA 13, Table 2-3.1 may be installed in wet automatic sprinkler systems in accordance with their listing, subject to the following restrictions:
- (a) Portions of a system which are constructed from heat sensitive materials shall be installed behind an approved thermal barrier.
 - (b) Concealed spaces in which combustible piping is installed shall be fitted with an approved smoke detection system. The fire detection alarm signal shall be supervised at the central safety station and shall clearly show the location of the detector that has been activated.
 - (c) Piping materials shall be listed for the intended service and installed according to the listing requirements. Materials which are not listed may be permitted provided that they are shown to meet the performance requirements of the International Maritime Organization guidelines published in Maritime Safety Committee Circular 580 (MSC/Circ.580).
- 2-4 Add: Fittings which may be exposed to salt water must be protected against corrosion by hotdip galvanizing or by the use of extra heavy schedule material. (See 46 CFR 56.60-3(a).)
- 2-4.2 Modify: Materials other than those meeting the requirements of NFPA 13, Table 2-4.1 may be installed in wet automatic sprinkler systems according to their listing subject to the following restrictions:

- (a) Portions of a system which are constructed from heat sensitive materials shall be installed behind an approved thermal barrier.
- (b) Concealed spaces in which combustible piping is installed shall be fitted with an approved smoke detection system. The fire detection alarm signal shall be supervised at the central safety station and shall clearly show the location of the detector that has been activated.
- (c) Piping materials shall be listed for the intended service and installed according to the listing requirements. Materials which are not listed may be permitted provided that they are shown to meet the performance requirements of the International Maritime Organization guidelines published in MSC/Circ.580.

2-5.2 Modify: Welding shall be accomplished in accordance with 46 CFR 56.30-5 and 56.70 to the satisfaction of the Officer in Charge, Marine Inspection.

2-5.2.1 Delete.

2-5.2.8 Modify: Qualification of the welding procedures to be used and the performance of welders and operators is required and shall comply with the requirements of 46 CFR, Subchapter F, Part 57.

2-5.2.8.1 and 2-5.2.8.2 Delete.

2-5.4 Add: Brazed joints shall comply with the requirements of 46 CFR 56.30-30 and 56.75. Brazing alloy shall have a melting temperature of at least 926.7°C (1700°F) except lower temperatures may be permitted where heat sensitive piping is installed. (See paragraphs 2-3.5 and 4-5.)

2-5.4 Modify: Exceptions 1 and 2: Soldering of joints may be permitted only in areas where heat sensitive piping is installed. (See paragraphs 2-3.5 and 4-5.)

2-5.5 Modify: Joining of plastic piping shall be in accordance with their listing.

2-6 Add: Pipe supports shall comply with the following:

- (a) Pipe supports shall be designed to support five times the weight of the water filled pipe plus at least 100 kg (220 lb) at each point of piping support.
- (b) When designing supports, the selection and spacing of pipe supports should take into account the pipe dimensions, mechanical and physical properties of piping materials and supports, operating temperature, thermal expansion effects, external loads, thrust forces, vibration, maximum accelerations to which the system may be subjected, and the type of support.
- (c) Pipe supports shall be designed to provide adequate lateral, longitudinal and vertical sway bracing. While the degree of bracing will vary with the route and operation of the vessel, bracing shall be designed to ensure that:
 - (1) Slamming, heaving and rolling will not shift sprinkler piping, potentially moving sprinkler heads above ceilings, bulkheads or other obstructions.

- (2) Piping and sprinkler heads will remain in place at a steady heel angle at least equal to the maximum required damaged survival angle.
- (d) Pipe supports shall be welded to the structure. Hangers which can loosen during ship motion or vibration, such as screw down type hangers, shall not be permitted.

It is recommended that the designer review the requirements for automatic sprinkler systems that are subject to earthquakes. While it is obvious that shipboard motions and accelerations differ from those that occur during an earthquake, the general principle of protecting the piping system against damage applies. One should consider that the differential motion between floors anticipated by NFPA 13 will not be a substantial factor on most ships. Individual hangar design, however, will be very similar. (See NFPA 13, paragraph 4-5.4.3.)

2-6.1.1 Modify: The components of hanger assemblies that are welded directly to the ship structure need not be listed.

2-6.1.2 Exception Modify: Nonferrous hangers and components are permitted where the following exceptions exist:

- (a) Ships are constructed from materials other than steel. Hangers and supports may be constructed from heat sensitive materials provided that they are suitably insulated. Aluminum materials shall be insulated in accordance with the method given in SNAME Technical and Research Bulletin 2-21, "Aluminum Fire Protection Guidelines".
- (b) In areas where heat sensitive piping is installed in accordance with paragraph 2-3.5 and 2-4.2.

2-6.1.4 through 2-6.1.6 Delete.

2-6.2 Delete.

2-6.3.1 Modify: Power driven studs shall not be used. Studs, however, may be welded in place. Hangers should be welded to primary structural members of the vessel such as beams, girders and stiffeners.

2-6.3.2 Delete.

2-6.4 Modify: The size of rods and U-hooks shall be increased, as necessary, to account for service and operational loading, including ship motion and vibrations.

2-6.4.1 Exception: Delete.

2-6.4.5 through 2-6.4.10 Delete.

2-7.1.1 Add: All valves shall be supervised from a central safety station. Overboard discharges and shell connections shall comply with the requirements of 46 CFR 56.50-95 and be corrosion resistant in accordance with 46 CFR 56.60. Zone valves shall also meet the requirements of this paragraph.

2-7.2 Add: Drain and test valves shall meet the applicable requirements of 46 CFR 56.20 and 56.60.

2-7.3 Add: Valve markings shall include the information required by 46 CFR 56.20-5(a).

This document supplements NFPA 13. Paragraphs in NFPA 13 are applicable unless changed herein.

2-8.1 Add: Fire department connections shall consist of both of the following:

- (a) An internal threaded swivel connection having threads compatible with those of the local fire department; and
- (b) An international shore connection. Specifications for international shore connections are defined in 74 SOLAS 11-2/19 (see figure 4.1).

Selection of the pipe thread for the fire department connection should be done very carefully. It is recommended that a 2-1/2 inch siamese connection with National Standard Hose Thread be used since a majority of fire departments will be compatible with this thread. However, it must be noted that some fire jurisdictions may not be compatible with a connection of this type. Serious consideration should be given to the vessel's typical operating area. Precautions and planning should avert the possibility of the vessel being forced ashore by fire at a location where the fire company is not compatible with this connection. Carriage of extra fittings and pre-voyage arrangements with all applicable jurisdictions should be considered. The international shore connection is required to ensure that all vessels fitted with sprinkler systems have at least one type of common connection.

2-9.1 Add: The audible alarm shall be given at the central control station within thirty seconds of water flow as required by this paragraph.

2-9.5 Add: Electrically operated attachments shall meet and be installed in accordance with the requirements of 46 CFR, Subchapter J (Electrical Engineering). All wiring shall be chosen and installed in accordance with IEEE 45, Marine Supplement.

Chapter 3 System Requirements

3-1.2 Add: Special consideration should be given to the installation of relief valves in all systems. Ambient ship temperatures can vary greatly depending on operating environment, duration of voyage and failure of climate control systems.

3-2.6.2 Add: The air supply shall have the ability to restore air pressure in not less than 10 minutes. In addition, the air supply shall be available on passenger ships at all times when passengers are present.

3-3.1.4 Add: The number of spare fusible elements that shall be carried per temperature rating is as follows:

- (a) Vessels shall have 2 spare fusible elements when operating voyages are normally less than 24 hours.
- (b) Vessels shall have 4 spare fusible elements when operating voyages are normally more than 24 hours.

3-3.2.3 Modify: All sprinkler systems shall be supervised.

3-3.2.4 Add: All pendent sprinklers shall be installed with return bends to prevent sediment buildup. Consideration shall be given concerning the intrusion of saltwater into the system. Specifically, sprinkler heads shall not be rendered ineffective by corrosion related to saltwater entrapment within the return bend.

This document supplements NFPA 13. Paragraphs in NFPA 13 are applicable unless changed herein.

- 3-4.1.3 Modify: The number of manually operated call points shall be in accordance with SOLAS 11-2/13.2.1. That is, one manually operated call point shall be located at each exit and call points shall be readily accessible in the corridors of each deck such that no part of the corridor is more than 20 m (65 ft) from a manually operated call point. When cargo spaces are protected with automatic sprinkler systems manual call boxes shall be installed at each exit.
- 3-5.2.3 Add: The temperature for which the antifreeze solution will protect the system shall be reviewed and accepted by the Officer in Charge, Marine Inspection. Local climatic conditions within the operating area shall be used to determine the temperature to which the system is protected.
- 3-6 Delete.
- 3-7.2 Add: Water supply for exposure protection systems may be provided by the dedicated sprinkler pump or fire pump. Pump size shall be increased to handle the additional water demand of the exposure protection system. An additional connection for off-ship water supply may be fitted. See chapter 7 for detailed water supply requirements.
- 3-7.3.4 Add: Specific proposals should be submitted to Marine Safety Center for approval.
- 3-7.6 Delete. Sprinkler orifice sizes of less than 9.5 mm (3/8 inches) shall not be installed.
- 3-7.8 Delete reference to sprinklers smaller than 9.5 mm (3/8 inches).

Chapter 4 Installation Requirements

- 4-3.1.1 Exception Modify: Deviations made under this exception shall be to the satisfaction of the Commanding Officer, Marine Safety Center.
- 4-3.1.3.2(e) Modify: This item includes systems installed under a non-insulated steel deck which is exposed to sunlight.
- 4-3.6 Add: Residential style sprinkler heads shall be permitted only in locations in "hotel" style accommodation areas that would otherwise be considered Light Hazard Occupancies. Accommodation areas fitted primarily with multiple staterooms and corridors are considered "hotel" style accommodation areas. Where it is desirable to install residential style sprinklers in other areas that are designated Light Hazard, a specific proposal should be made to and approved by the Commanding Officer, Marine Safety Center.
- 4-4.1.7 Add: The following shall be added to this section:
- (a) Where a ceiling of smooth ceiling construction, as defined by paragraph A-1-4.6(b)(iii), is not continuous (i.e., it has openings) between deck to deck A- or B-Class rated boundaries within a space or group of spaces protected the following is required.
 - (1) The openings in the ceiling shall be protected in a manner similar to that described in paragraph 4-4.1.7.3.4 of NFPA 13. Specifically, 0.46 m (18 in) draft stops shall be installed around the opening. Sprinkler heads, however, need not be installed in 1.8 m (6 ft) intervals as would be required if the deck itself were open; and
 - (2) The concealed space shall be sprinklered throughout the affected area.
This document supplements NFPA 13. Paragraphs in NFPA 13 are applicable unless changed herein.

For the purposes of this requirement, a ceiling is continuous if it is not fitted with openings or grated panels that would allow heated combustion gasses to pass from the fire effected space into the concealed space above the ceiling. The area effected by this provision shall extend within the concealed space to the first A- or B-Class rated boundary such as a draft stop, deck to deck bulkhead panel or divisional bulkhead.

- (b) Where required, windows shall be protected as outlined below:
- (1) Automatic sprinkler heads shall be spaced no more than 1.8 m (6 ft) apart along the length of the window glazing. Baffles shall be installed where required in accordance with paragraph 4-4.1.7.8.
 - (2) Automatic sprinkler heads shall be not further than 0.3 m (1 ft) from the window so that water from the sprinkler will cover the entire surface of the window glass. Window blinds, draperies or other obstructions shall not be placed between the sprinkler and the window glass.
 - (3) Alternative spacing arrangements that are based on testing may be permitted by the Commanding Officer, Marine Safety Center.
 - (4) It shall be demonstrated through simulation or test that automatic sprinkler head arrangements fully wet the glazing assembly to the satisfaction of the Commanding Officer, Marine Safety Center.
 - (5) The water demand of automatic sprinkler heads protecting windows shall be added to the water demand calculations as an addition to that which is required by any method in paragraph 5-2.3. For example, a design area of 139.3 m³ (1500 square feet) is used to design a sprinkler system for an unobstructed Light Hazard occupancy. In this case, the system must supply at least 7 sprinklers that are installed within that area. If 8 sprinklers are installed to protect windows within this design area, the water demand of these sprinklers is added to the total water demand. Thus, 15 sprinklers must be supplied by this system.
 - (6) Water shall be applied in a density not less than 75 l/mm (20 gpm) per meter width of glazing.
 - (7) Ceiling heights in the vicinity of the window protection sprinklers should not be greater than 3 m (10 ft). Such ceilings should extend at least 3 m (10 ft) into the space, to allow a ceiling jet or hot layer to actuate the sprinklers protecting windows.

4-4.1.7.1.1 Modify: Concealed spaces which are constructed of combustible materials, materials with combustible finishes or which contain significant quantities of combustible materials, such as piping, shall be sprinklered. The exact amount of combustible materials that may be permitted without sprinkler protection is not specifically defined. If combustibles are present such that they constitute a threat, the space should be sprinklered. One example would be the presence of large bundles of unsheathed computer or electric cable. Typical amounts of lighting or control cabling should not be considered to constitute a fire threat.

4-4.1.7.2.1 Modify: The exceptions are acceptable only if the shaft is surrounded by an A-Class enclosure.

4-4.1.7.3 Add: Stairway enclosures fitted with carpet, combustible finishing or overlay materials, or furnishings shall be fully sprinklered.

4-4.1.7.3.2 Exception: Delete: Storage of combustible materials under stairs is not permitted.

- 4-4.1.7.6.1 Modify: This requirement would apply if the area below the canopy was outfitted with combustible furnishings or material storage.
- 4-4.1.7.7.1 Modify: Omission of sprinklers in bath modules (full room modules) constructed with combustible materials shall not be permitted, regardless of room fire load. Where thermal barriers are used to otherwise permit omission of sprinklers in bathrooms, piping and electrical penetrations of the thermal barrier shall be in accordance with the guidance contained in NVIC 6-80.
- 4-4.1.7.8 Add: Baffles shall be constructed of noncombustible materials.
- 4-4.1.7.14 Delete: Drop out ceilings shall not be used.
- 4-4.1.7.17 Modify: This requirement does not imply that NFPA 231 or 231C are approved for use. These standards may or may not apply, Commandant (G-MTH-4) should be contacted regarding suitable protection of rack storage arrangements.
- 4-4.1.7.20 Add: To prevent sediment buildup, return bends shall be installed in all shipboard sprinkler systems where pendent-type sprinklers are used in wet systems (See NFPA 13, figure 4-4.7.20). Consideration shall be given concerning the intrusion of saltwater into the system. Specifically, sprinkler heads shall not be rendered ineffective by corrosion related to saltwater entrapment within the return bend.
- 4-4.1.7.20 Exception 2: Delete.
- 4-4.1.7.22-24 Delete.

4-5 The following requirements shall be added:

- (a) Portions of the piping system constructed with a heat sensitive material permitted by paragraph 2-3.5 shall be subject to the following restrictions:
 - (1) Heat sensitive piping may be used in single deck areas or a single multideck area, such as an atrium, where the areas are surrounded by the boundaries of A-Class divisions.
 - (2) Piping shall be of non-heat sensitive type from the sea suction up through the penetration of the last A-Class division enclosing the space(s) in which the heat sensitive piping is installed.
 - (3) Draft stops meeting at least a B-O rating shall be fitted not more than 13.7 m (45 feet) apart between the thermal barrier (see definitions) and the deck or shell.
 - (4) Zone valves shall be installed as required in section 4-5.1.1.

Note: The objective of these requirements is to protect risers and cross mains, and to ensure that fire damage within one space or group of spaces will not inhibit the performance of the remainder of the sprinkler system. Heat sensitive piping, as restricted by the above, shall not be led between two spaces that are required to be separated by A-Class divisions.

- 4-5.1.1(a) Add: Each zone in which heat sensitive piping is used (under the provisions of paragraph 2-3.5) shall be fitted with a valve capable of segregating that zone from the remainder of the system. The valve shall be supervised and be located within a normally manned control station or Type 1 stair.
- 4-5.1.1.1 Add: Indicating valves shall be supervised.
- 4-5.1.1.2 Add: All supply and zone valves within the system shall be supervised. Shipboard installations will normally require more than one valve per water supply.
- 4-5.1.1.3 Modify: (a) Valves shall be monitored from a central safety station.
- 4-5.1.1.3 Modify: (b) This is acceptable provided that the attending point is a central safety station.
- 4-5.1.1.3 Modify: (c) Locking valves in the open position is not an acceptable substitute for 4-5.1.1.3 (a) and (b), but can be done in addition to these other requirements.
- 4-5.1.1.3 (d) Delete.
- 4-5.1.1.7 Delete.
- 4-5.2.1.1 Modify: Sprinkler piping shall be supported by the primary structural members of the vessel such as beams, girders and stiffeners.
- 4-5.2.1.1 Exception: Delete.
- 4-5.2.1.2 Delete. See comment to 4-4.1.7.17, above.
- 4-5.2.2.1 Exception No. 3: Delete.
- 4-5.3.6.1 Modify: Drain lines shall not be connected to housekeeping, sewage or deck drains. Drains may discharge to bilges. Overboard discharges shall meet the requirements of 46 CFR 56.50-95. Systems which contain water additives that may not be discharged into the environment shall be specially designed to prevent such discharge.
- 4-5.3.6.2 Delete.
- 4-5.3.6.4 Modify: Discharges shall be arranged so that they do not present a safety hazard. Installation of a down turned elbow, as required here, is recommended for any non-shell connections.
- 4-5.4.2.1 Add: Systems which can be exposed to saltwater shall comply with 46 CFR 56.60-3(a). Where exposure to corrosive chemicals or other materials is possible, systems should be adequately designed to resist exposure to the environment. Specific design proposals shall be made to the Commanding Officer, Marine Safety Center.
- 4-5.4.2.2 Add: This paragraph shall apply to all systems that are exposed to saltwater or otherwise corrosive water.
- 4-5.4.2.4 Delete.

- 4-5.4.3 Modify: Earthquake protection does not apply to ships, however, motions are similar to those that a ship will experience in a seaway. The design principles discussed in this section could be used as a guide to shipboard system design. See 2-6.1(d).
- 4-6.1 Add: A visual and audible alarm signal shall be given at the central safety station to indicate when the system is in operation or when a condition that would impair the satisfactory operation of the system exists. Alarm signals shall be provided for, but not limited to, each of the following: monitoring position of control valves, fire pump power supplies and operating condition, water tank levels and temperatures, zone water flow alarms, pressure of tanks, and air pressure on dry-pipe valves. Alarms shall give a distinct indication for each individual system component that is monitored. While not required, a dual annunciator alarm panel system is recommended. One panel should show the piping system layout and indicate status of zone valves, tank pressures, water supply valves, pump operation, etc. The second panel should show the vessels general arrangement and indicate status of water flow (i.e., fire location) alarms.
- 4-6.1.1.5 Delete.
- 4-6.1.1.6 Modify: The following shall be applied to all systems:
- (a) Water flow alarms shall be installed within every zone of the sprinkler system and on every deck such that an alarm indication can pinpoint the location of the fire to a specific deck and Main Vertical Zone (MVZ) or A-Class surrounding if a MVZ is not required. Annunciator panels shall be installed at the central safety station.
- 4-6.1.1.6 Exception: Delete.
- 4-6.2.1 Add: In addition to the fire department connection, an International Shore Connection (ISC) meeting ASTM Standard F 1121-87 shall be installed in similar fashion to the fire department connection on board all vessels. Installation of an additional fire boat connection may be required by the Officer in Charge, Marine Inspection on board vessels whose route is such that regular access to fire boats is possible. An additional fire boat connection may not be necessary when fire boats are equipped to connect to the regular fire department connection. (See the comments of paragraph 2-8.1 of this NVIC.)
- 4-6.2.1 Exceptions 1 and 2: Delete.
- 4-6.2.3.2 Delete exception.
- 4-6.2.3.3 Delete exception.
- 4-6.2.3.4 Add: Connections shall be located near gangway or other shore access point so that they are readily accessible to the fire company. Fire department connections shall be colored and marked so that the connections are easily located from the shore access point (i.e., gangway location) and will not be confused with a firemain connection. An 0.46 x 0.46 m (18 x 18 inch) sign displaying standard symbol 1 of paragraph 6-2, NFPA 170 shall be placed at the connection so that it is in plain sight from the shore access point. Connections on both sides of the vessel may be necessary depending on the shore access arrangements.

- 4-6.4.2 Modify: Test connections shall be installed as close to the most hydraulically remote location as is practical. When test connections are below the bulkhead deck, they shall comply with the overboard discharge arrangements of 46 CFR 56.50-95.

Chapter 5 Design Approaches

- 5-2.2 Delete. The pipe schedule method shall not be used to determine the water demand requirements.
- 5-2.3 Add: Minimum water supply requirements shall include sprinklers that are installed for the protection of windows as described in paragraph 4-4.1.7.
- 5-2.3.1.1 Modify: Hose stream flow need not be added to the water demand. The water supply for fire hoses is separately supplied through the fire main by fire pump(s).
- 5-2.3.1.1 Exceptions 1 through 3: Delete.
- 5-2.3.1.2 Modify: Figure 5.1 shall be used in lieu of NFPA 13 figure 5-2.3.
- 5-2.3.1.3(b) Delete: Unsprinklered combustibile concealed spaces shall not be permitted.
- 5-2.3.1.3(b) Exception 2-3: Delete.
- 5-2.3.1.3(d)-(h) Delete.
- 5-2.3.2.1 and 2 Modify: Figure 5.1 shall be used in lieu of NFPA 13, Figure 5-2.3, "Area/Density Curves."
- 5-2.3.3.1 Modify: Delete reference to NFPA 13, Table 5-2.3. Decks and bulkheads shall be rated as required by the applicable Subchapter of Title 46 CFR or SOLAS 74, whichever is greater.
- 5-3.2.4 Delete.
- 5-3.4.1 Add: Specific protection proposals for the use of large drop sprinklers should be made to Commandant (G-MTH).
- 5-3.4.5 Delete.
- 5-3.5 Add: Proposals for use of Early Suppression Fast Response sprinklers shall be made to Commandant (G-MTH-4). Use of these sprinklers shall be permitted only when suitable use for the specific application has been proven by large-scale or other suitable fire testing.

Chapter 6 Plans and Calculations

- 6-1.1 Modify: Plans shall be submitted to the Commanding Officer, Marine Safety Center.

- 6-1.1.1 Modify: Plans shall also include detailed drawings, calculations and specifications of the water supply. The information provided shall be to the satisfaction of the Commanding Officer, Marine Safety Center.
- 6-2.2 Modify: The summary sheet shall also include a description of each occupancy to be protected and design assumptions, including assumptions concerning areas where the cargo or provisions may be stored.

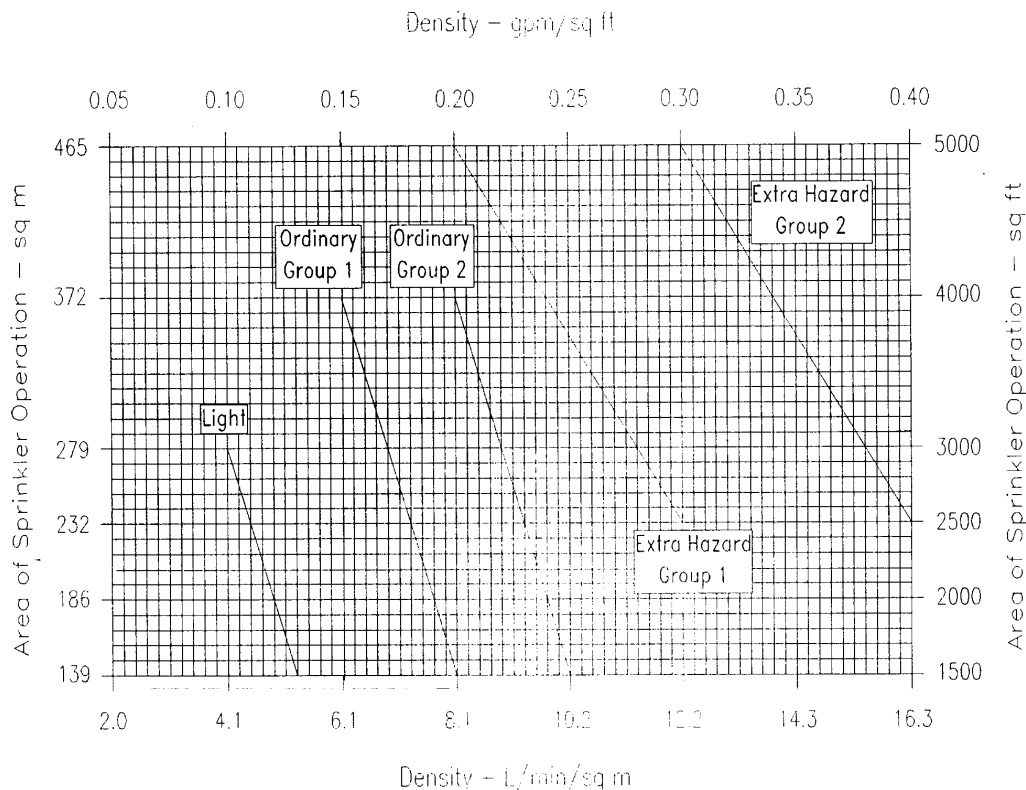


Figure 5.1: Area/Density Curves - Replaces NFPA 13, Figure 5-2.3

- 6-3 Modify: In addition, the pressure tank size, high pressure relief setting, high and low water alarm settings, low pressure alarm setting, and pump start pressure shall be provided.
- 6-4.4.6 Exceptions 1 and 2 Modify: All sprinklers installed within spaces of a particular occupancy classification shall have the same orifice size. Sprinklers specifically installed for the protection of windows under paragraph 4-4.1.7 may be of a different size than those protecting the remainder of the occupancy classification. All of the window sprinklers, however, shall be of the same size.

Chapter 7 Water Supplies

The water supply requirements of NFPA 13 shall be replaced with the requirements given below:

1. Pressure Tank:

- (a) The pressure tank shall be constructed so that:
 - (1) The tank shall contain a standing charge of fresh water equal to that specified by Table 7.1.
 - (2) Tank volume is equal to at least twice that of the standing charge of water required below.
 - (3) A glass gauge shall be provided to indicate the correct level of water within the pressure tank.
 - (4) The tank shall be capable of providing water to the hydraulically most remote design area at the design pressure until the sprinkler pump provides this water supply.
 - (5) Arrangements shall be provided for maintaining an air pressure in the tank such that while the standing charge of water is being expended, the pressure will not be less than that necessary to provide the design pressure and flow of the hydraulically most remote design area.
 - (6) Suitable means of replenishing the air under pressure and fresh water standing charge in the tank shall be provided.
 - (7) Tank construction shall be in accordance with the applicable requirements of 46 CFR, Subchapter F (Marine Engineering).

Table 7.1: Required Water Supply

System Type	Additional Water Volume
Wet Pipe System	One minute of system demand
Dry Pipe System Preaction System Deluge system	One minute of system demand plus the volume needed to fill all dry piping

- (b) Relief valves should be installed on the tank to avoid over pressurization and false actuation of the dry pipe valve. Relief valves shall comply with 46 CFR 54.15-10.
- (c) Low water, high water, air system failure and low pressure alarms shall be fitted. Alarms shall report to the central safety station. (See 46 CFR 76.25-20.)

- (d) The air compressors which supply the air to the pressure tank shall be supplied power as required in 46 CFR 76.25-35(c).
- (e) More than one pressure tank can be installed provided that each is treated as a single water source when determining valve arrangements. Check valves shall be installed to prohibit flow from tank to tank or from pump to tank.
- (f) In systems subject to use with saltwater, valves shall be so arranged as to prohibit contamination of the pressure tank with saltwater.
- (g) Where applicable, means shall be provided to restrict the amount of air that can enter the pressure tank from the air supply system. The purpose being to ensure that the pressure tank air supply will not keep the tank "fully" pressurized while water is expelled, thus preventing pump actuation. A means shall also be provided to prevent water from back flowing into the air supply system.

2. Sprinkler Pump:

- (a) An automatically controlled pump shall be provided to supply the sprinkler system and shall be used for no other purpose, except where the fire pump is allowed to serve as a second sprinkler pump. (See 46 CFR 76.25-15(a).)
- (b) The pump shall be sized to meet the water demand determined by hydraulic calculation.
- (c) The system shall be designed so that before the water flow and pressure from the tank(s) falls below that required for adequate system operation, the sprinkler pump shall be automatically started and shall supply water to the system until manually shut off. (See 46 CFR 76.25-35(a).)
- (d) The power supplies specified in 46 CFR 76.25-35(c) shall be provided for the sprinkler pump.
- (e) A test valve shall be installed on the discharge side of the pump with a short open-ended discharge pipe. The area of the pipe shall be adequate to permit the release of the required water output at the required system pressure. (See SOLAS 74, 11-2/12.5.3.)
- (f) Where two sprinkler pumps are required to ensure the reliability of the water supply, each pump should meet the requirements of paragraph 2(a)-2(d), above. In addition, a system which is required to have more than one pump shall be designed to accommodate the following features:
 - (1) Pump controls and system sensors shall be arranged such that the secondary pump will automatically operate if the primary pump fails to operate or deliver the required water pressure and flow. Figure 7.1 is an example of an acceptable dual pump arrangement.
 - (2) Both pumps shall be served from normal and emergency power sources. However, when approved by the Commanding Officer, Marine Safety Center, the secondary pump may be non-electrically driven.
 - (3) Pump failure and operation shall be indicated at the central safety station.

This document supplements NFPA 13. Paragraphs in NFPA 13 are applicable unless changed herein.

- (4) Pumps should not be located within the same compartment. However, where this is not reasonable or practical, special attention shall be given to protecting pumps such that a single failure will not render the sprinkler system inoperative.

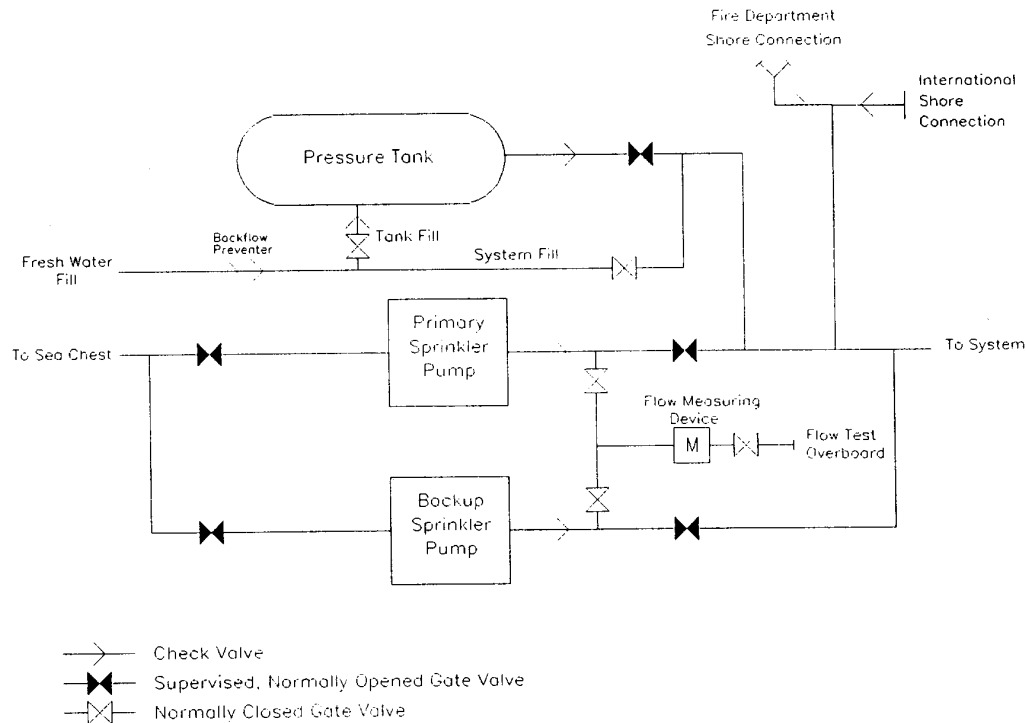


Figure 7.1(a): Abbreviated Example of a Dual Sprinkler Pump Water Supply

- (5) If not specifically prohibited, the fire pump may be used as the second pump provided that:
- (i) The pump is adequately sized to meet the required fire hose and sprinkler system pressure and flow demands simultaneously;
 - (ii) The fire main system is segregated from the sprinkler system by a normally closed valve that is designed to automatically open upon failure of the designated sprinkler pump; and
 - (iii) The fire pump is automatically started in the event of dedicated sprinkler pump failure or loss of pressure in the sprinkler main.
3. The pressure tank and sprinkler pump shall be situated in a position reasonably remote from any machinery space of Category A. (See SOLAS 74, 11-2/12.6.)
 4. All valves within the water supply piping system shall be supervised

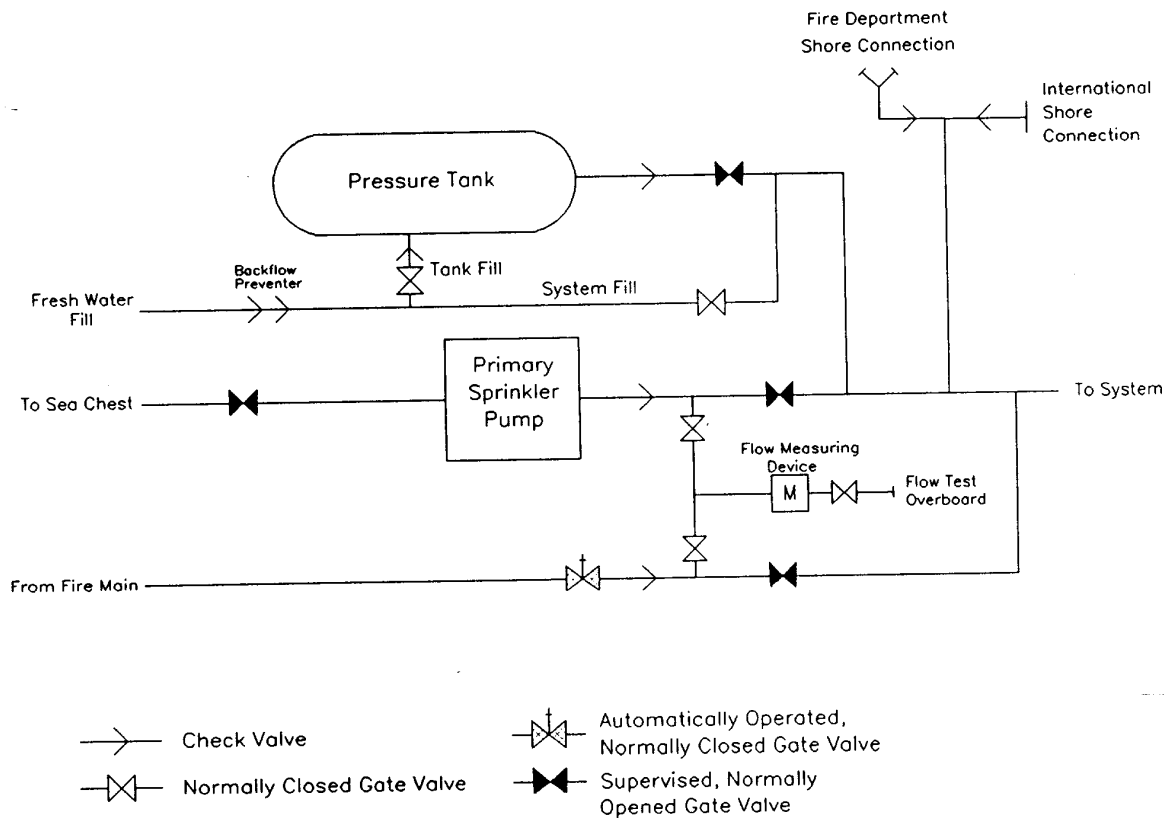


Figure 7.2: Abbreviated Example of a Water Supply with Fire Pump Backup

5. The sprinkler system shall be cross connected with the ship's firemain system and fitted with a lockable screw-down nonreturn valve such that backflow from the sprinkler system to the fire main is prevented (74 SOLAS 11-2/8). Figure 7.2 is an example of a typical system arrangement.
6. The piping, tanks and pumps that make up the water supply shall be installed in accordance with the applicable requirements of 46 CFR, Subchapter F (Marine Engineering).
7. Pump operation shall be indicated at the annunciator panel in the central safety station.
8. When a shore water supply is to be used during extended dock side periods the water supply shall be qualified in the manner described in paragraphs 7-2.1 and A-7-2.1 of NFPA 13. Tests shall be conducted in accordance with the requirements of the local shore-based authority having jurisdiction. The water supply information listed in paragraph 6-3 of NFPA 13 shall then be provided to the Officer in Charge, Marine Inspection. This procedure shall be used to qualify each water supply to which the vessel may be attached. For example, this may require testing of multiple hydrants or connections in the same mooring area. The effect of the hose or piping leading from the water supply to the ship shall also be considered when qualifying each hydrant.

Chapter 8 System Acceptance

- 8-1 Add: Arrangements for inspection and testing the system shall be made with the Officer in Charge, Marine Inspection. In no case shall a system be approved until plan review, including the resolution of any deficiencies noted, is completed to the satisfaction of the Commanding Officer, Marine Safety Center. Where other organizations are permitted to act on behalf of the Coast Guard arrangements for inspection, testing and plan review may be made directly with that organization.
- 8-2.2.3 Add: This test shall also be conducted on any external water supply connections such as international shore and fireboat connections.
- 8-2.4.1 Modify: A waterflow test shall result in an alarm within thirty seconds after flow through the test connection begins.
- 8-2.4.3 Modify: Pressure tank and pump operation, valve actuation and water flow shall also be tested. Pump operation and performance shall be tested in accordance with Chapter 11, NFPA 20.

Chapter 9 System Maintenance

The maintenance requirements of NFPA 13 shall be replaced with the following:

1. Sprinkler systems shall be inspected, tested and maintained in accordance with Chapter 2, NFPA 25.
2. Sprinkler pumps and any fire pumps that are cross connected to the sprinkler system shall be inspected, tested and maintained in accordance with Chapter 5, NFPA 25.
3. The pressure tank shall be inspected, tested and maintained in accordance with 46 CFR, Subchapter F, Marine Engineering and Chapter 6, NFPA 25. Where these two standards conflict, the Code of Federal Regulations shall take precedence.
4. System valves and fire department connections shall be inspected, tested and maintained in accordance with Chapter 9, NFPA 25.

Due to the relatively new use of automatic sprinklers on U.S. vessels, it is recommended that the owner engage the services of an independent (third party) agency or company to perform the fire protection system testing and inspection required above.

5. Instructions for the operation, inspection, maintenance, and testing shall be kept in the cabinet containing the spare sprinklers.
6. Impairments to the system shall be handled in accordance with Chapter 10, NFPA 25, except that inspections, maintenance and testing should not be conducted when the vessel is at sea. Extended periods of impairment shall not be scheduled for periods when passengers or cargo are on board the vessel. Log entries shall be made whenever a system impairment occurs or is removed. In addition, shipboard fire fighting personnel shall be on board the vessel and notified whenever portions of the system are impaired.

7. A separate card or booklet with tabulated spaces for the date and signature of the licensed officer of the vessel who shall witness or conduct inspections, maintenance and tests shall also be kept in the cabinet containing the spare sprinklers.

Chapter 10 Referenced Publications

- (a) NFPA 13, "Standard for the Installation of Sprinkler Systems," 1991 Edition, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.
- (b) NFPA 13R, "Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height," 1991 Edition, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.
- (c) NFPA 20, "Standard for the Installation of Centrifugal Fire Pumps," 1993 Edition, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.
- (d) NFPA 25, "Standard for Inspection, Testing, and Maintenance of Water-based Fire Protection Systems," 1992 Edition, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.
- (e) NFPA 170, "Standard for Fire Symbols," 1991 Edition, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.
- (f) Title 46, Code of Federal Regulations, Subchapter H, Subpart 76.25 (Automatic Sprinkling System, Details).
- (g) Title 46, Code of Federal Regulations, Subchapter F, (Marine Engineering).
- (h) International Convention for the Safety of Life at Sea, International Maritime Organization, London, UK.
- (i) SNAME Technical and Research Bulletin No. 2-21, "Aluminum Fire Protection Guidelines," July 1974, Society of Naval Architects and Marine Engineers, 601 Pavonia Ave, Jersey City, NJ 07306.
- (j) Maritime Safety Committee Circular 580, "Guidelines for the Application of Plastic Pipes on Ships," 21 December 1992, International Maritime organization, London, UK.